RADFORD ORDNANCE WORKS
(Original)

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Part 3

History

Hercules Powder Company
Overall History of Operations
16 August 1940 to 1945

HISTORICAL REPORT

of

RADFORD ORDNANCE WORKS

GOVERNMENT-OWNED

HERCULES POWDER COMPANY - OPERATED

RADFORD, VIRGINIA

AUGUST 16, 1940 THROUGH 1945

By

HERCULES POWDER COMPANY

Volume III of 3 volumes, with photographic supplement

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finished. All equipment, construction materials, and materials in process needed at the Radford Ordnance Works should be transferred to that plant. Further dismantling and disposition of buildings and materials will have to wait instructions from the Ordnance Office. Such instructions have been requested by teletype this date."

On August 29, 1942, a letter was received by Col. Booth from the Office of the Field Director of Ammunition Plants, St. Louis, Missouri, substantiating the above letter, and, also, according to Paragraph ID to "Raze all buildings, structures, and unsalvagable material, policing the grounds around the buildings."

By October 1, 1942, all personnel had either been terminated or transferred to various Hercules plants, and the real estate had been returned to the care of the United States.

B. NEW RIVER ORDNANCE PLANT

1. Change in Status of New River Ordnance Plant

Prior to September 19, 1943, the New River Ordnance Plant, twelve miles from the Radford Ordnance Works, was operated by Hercules Powder Company as a separate plant, in accordance with Contract W-ORD-492, dated December 17, 1940. Until May 21, 1943, the plant, including its storage magazines, was operated as a Bag-loading Plant for assembling smokeless-powder propellant charges. On May 20, 1943, in accordance with instructions from the Ordnance Department and confirmed in writing on May 20, 1943, which formal confirmation was embodied in Supplement No. 6, dated January 25, 1944, the bag-loading operations ceased and action was started immediately to put the production units of the plant in standby condition. The storage magazines were operated from May 21, 1943, to September 19, 1943, as a Storage Depot.

During the period from May 21, 1943, to September 18, 1943,

several hundred employees remained on the New River payroll while the termination was in process.

Change Order 15, dated August 11, 1943, to Contract W-ORD-462 DA-W-ORD-26 (Radford Ordnance Works) was a formal confirmation of instructions authorizing Hercules to "take all steps necessary to procure and install the additional facilities at the New River Ordnance Plant necessary to provide for water-proofing Mortar Increments manufactured under, and identified in, Contract W-ORD-462 xx." That supplement also provided that Hercules would "upon completion of the termination work under Contract W-ORD-492, as directed by the Contracting Officer from time to time, operate the New River Ordnance Plant as a storage depot, ..."

At 12:01 A.M., on September 19, 1943, the New River Ordnance Plant became a part of Radford Ordnance Works in accordance with the provisions of Change Order 15 to the prime Radford Ordnance Works Contract, W-ORD-462.

The full record of the New River Ordnance Plant while operating as a separate plant, that is, from its inception until September 19, 1943, and under the Radford Contract from September 19, 1943, until it was turned over to the U. S. Government appears in a separate volume.

2. Problems Encountered

Several problems presented themselves as preparations were made to place the New River Ordnance Plant under the Radford Ordnance Works Contract, the first of which involved transferring the New River employees to the Radford payroll. This was complicated from two angles: First, in many instances, the Radford rates and rate ranges were somewhat different from those of New River; and second, the New River work-week was from 12:00 midnight Sunday to 12:00 midnight Sunday,

whereas the Radford work-week was from 8:00 A.M. Sunday to 8:00 A.M. Sunday.

The first problem, the difference in wage and salary schedules, was settled at a meeting with the War Department Wage Administration Agency in Philadelphia on Monday, September 20, 1943, at which Mr. A. Van Beek and Mr. O. W. Benson, of Hercules Powder Company, Radford Ordnance Works; Mr. A. R. Hance, of Hercules Powder Company, New River; Mr. Robert Hunter, Jr., local field auditor for the Ordnance Department; and Mr. L. W. Babcock and Mr. J. R. L. Johnson, Jr., of Hercules Powder Company, Wilmington, were present. At this meeting the Wage Administration Agency approved a schedule which provided for uniform rates at the two locations.

At this point it might be interesting to relate that the difference in wage rates and salary rates which existed during the operation of the two plants under separate contracts had always been a source of considerable annoyance to the management of Radford Ordnance Works. In general, the rates, both wage and salary, were lower at Radford than at New River. Since the two plants were only twelve miles apart and since most operators and supervisors at Radford considered the work at Radford to be generally more difficult and somewhat more hazardous than that at New River, the workers and supervisors at Radford frequently complained about their lower rates. This was not an easy situation to handle. It is recommended that should occasion arise at some future date requiring Hercules to operate two separate establishments so located as to draw workers from the same labor market that the wage and salary schedules for the two establishments be set so that they would be identical for jobs of comparable difficulty and skill.

ORIGINAL

Referring to the problem of different work-weeks, the difficulty here was to see that no worker suffered through loss of over-time pay because of the change in work-weeks. With the approval of the commanding officer, it was decided that the period between 8:00 A.M. Sunday and 12:00 midnight Sunday for New River workers would be counted on either the Radford work-week for the period ending September 25th or the New River work-week for the period ending September 18th, whichever resulted in greater pay for the employee. If no difference existed, the time was counted on the Radford work-week. Of course following this time, the Radford work-week applied to all New River employees.

3. Preparing for the Packaging of Trench-mortar Increments

The problem of packaging trench-mortar increments in water-proof packages was a new one to Hercules. On or about July 21, 1943, Mr. Butler of Radford visited the Ivers-Lee Company of Newark, New Jersey, at the request of Mr. R. H. Dement in the Office of the Chief of Ordnance, Washington, D. C., to inspect methods of packaging various items in water-proof packages of cellophane, foil, etc. Following this trip and before Change Order 15 was finally issued, several more trips were made by Mr. Butler to discuss the problem with Mr. Dement and other interested parties. After the issuance of Change Order 15, it was decided that the quickest way to get equipped for the water-proofing operations was by means of Wrapade crimpers. In order to use these crimpers, it was necessary to purchase prefabricated bags sealed on three sides, the increments to be stuffed into these bags and the fourth side to be closed by heat seal, using the Wrapade crimpers. This type of operation was used to a considerable extent for special packaging jobs by the Ivers-Lee Company. While it was

realized that some type of automatic machine would be a great money and labor saver in accomplishing this job, there was no such machine on the market to our knowledge which could be guaranteed to do the work, since this was an entirely new idea to the Ammunition Industry. The idea was held in mind for a future day, however, even though the requirement to do the work on automatic packaging machines was removed from the contract.

Twenty Wrapade crimpers were purchased from the Ivers-Lee Company and installed in the No. 4 Loading Line at New River. Some preliminary work was done early in November. A sample shipment of 6,000 bags was received from Ivers-Lee Company on November 3, 1943, and some dummy increments were packaged that day. The following day some regular increments were packaged for the purpose of obtaining ballistic results on the packaged powder. The first regular production of water-proofed increments was started at 10:15 A.M., November 13, 1943. Many difficulties were encountered in this new operation, some of which will be described here.

One of the main problems was the type of cellophane selected by the Ordnance Department for the job. This cellophane was a Saran - coated cellophane which had never been produced commercially to any great extent and, consequently, had not been used by the various companies having experience with heat-sealing cellophane. According to the word passed on to us by the bag manufacturers, the material did not handle as well as other heat-sealing cellophanes. It was reported that the coating came off and gummed-up the jaws or rolls of the machines; that it was more critical as to temperature; and that it was generally more difficult to obtain a proper seal with this material. This resulted in making deliveries on bags slow and uncertain. Much the same difficulties as those encountered by the bag manufacturers

were encountered by us in our sealing operation. Furthermore, since there was at hand no recognized test by which to judge the quality of the seal, there was no real significant test as to the quality of the finished product. For lack of a better criterion, a vacuum test was set up in which the packaged increment was submerged in water and the number of leaks that occurred for a given vacuum were recorded. Since the loaded rounds were not normally subjected to vacuum, the significance of this test was questionable; however, it did furnish some information as to the relative quality of the workmanship from lot to lot, day to day, machine to machine, etc., and was still being employed both for control and acceptance testing at the end of the year -- a figure having been mutually agreed upon for use in acceptance testing.

A considerable problem existed in the matter of placing the finished increments in the cellophane bags before sealing. This problem was quite satisfactorily solved by a machine which was designed and built by Mr. Wenz of Radford.

Many minor problems were presented, all of which were overcome by the efforts of the supervisory personnel at New River and Radford assigned to this work. By the end of the year, as a result of constant study of job methods, minor changes in equipment layout, experience of the operators, etc., the new installation was obtaining almost the theoretical capacity of the Wrapade crimpers in use. The only major problem remaining was the procurement of satisfactory cellophane bags in sufficient quantity to meet production schedules.

4. Resume of Operation

Increment packaging operations at the New River Ordnance Plant was part of the Smokeless Powder Department at Radford and was under

the supervision of the smokeless powder superintendent. Mr. J. T. Syndor was area supervisor of the operation. The smokeless technical assistant and smokeless chemical engineers aided in both the technical problems and the supervisory problems encountered in this operation.

After a brief training period with dummy powder, actual packaging of trench-mortar increments was started on November 13, 1943. Originally only M3 increments for the 60 MM Trench Mortar were packaged; later, M1, M2, and M2A1 increments for the 81 MM Trench Mortar were packaged.

At the start of the operations, each cellophane bag or envelope was opened, and the powder increment was inserted by hand. This process was extremely slow. Poor quality resulted from straining and tearing the bags when the increments were inserted. The Radford Maintenance Department designed and built a simple machine for performing this operation. Powder increments were stacked in a vertical magazine, and a foot-operated plunger pushed the increment from the magazine into the cellophane bag. This left both of the operator's hands free for opening the bags and handling the packaged increments. At the start, this increased the number of increments an operator could bag from a range of 10 to 16 per minute to 25 to 50 per minute. After operators gained skill with the stuffing machine, much better efficiency was obtained. Maximum efficiency was usually not obtained until an operator had from nine months-to-a-year's experience with this machine. A major improvement in the quality of the packaged increment was obtained by the use of the stuffing machine.

Some modifications of the crimper were necessary to improve efficiency of the operation and the quality of the product. The crimpers were equipped with a clutch so that they would normally be stopped

between the crimping of each bag. By the installation of a false top on the crimper so that the increments would be at the same level as the slot in the feed plate, it was much easier for the operators to insert the bags into the crimper, thus permitting the machine to run continuously. This not only increased the efficiency of the operation but also reduced the number of bags which were pleated and wrinkled by the crimper. Before satisfactory operation of the crimper was obtained, it was necessary to realign the crimper jaws and in come cases "lap" the jaws together for better fitting. Eventually stainless steel was found to be a more satisfactory material for the crimping jaws than the bronze which was originally furnished; hence all jaws were changed to the stainless-steel type. The crimping jaws were heated electrically, and the heat was controlled by means of rheostats. The actual temperature of the jaws was determined at frequent intervals by means of a thermocouple and potentiometer.

After packaging it was necessary to inspect each packaged increment to be sure that the bag was properly sealed. It was also necessary to install fluorescent lights in order that the operator might readily see the various defects. What constituted a defect was not always clearly defined, and therefore the elimination of the defects depended to a considerable extent on the operators. When considerable difficulty with the quality was encountered, the inspection was very rigid. At other times only the more easily seen defects, such as string or powder in the seal of the bag or unsealed bags, were removed.

Because of the small amount of powder permitted at each operation, the servicing of the operation required a considerable number of operators. Since this part of the operation greatly influenced the

efficiency of the entire operation, it was given constant supervision to insure a steady flow of material to and from the various operations.

After the operation was well established, the supply of cellophane bags was found entirely inadequate. The Ivers-Lee Company adapted other machines to the manufacture of the cellophane bags, and other suppliers of the bags were found. When adequate manufacturing facilities for the bags were developed, a shortage of Saran-coated Cellophane was encountered. This was overcome by increased facilities for the manufacture of Saran-coated Cellophane and by the use of a du Pont Nitrocellulose-coated Cellophane.

The first automatic packaging machine supplied by the Ivers-Lee Company was installed and put into operation in October of 1944. The second machine followed shortly thereafter. These machines were a modification of a pill-packaging machine which Ivers-Lee had supplied to the Miles Laboratory. They were put into operation with very little difficulty and performed well from the start. The use of these machines more than doubled the efficiency of the packaging operation. The most notable change, however, was the very great improvement in the quality of the packaged powder. Certain difficulties with these machines were encountered. Considerable experience was required on the part of the maintenance men before they could make the necessary adjustments without loss of time. Temperature controllers were installed in these machines. These were a great help in assuring the proper sealing temperature at all times. The quality of the operators required by the automatic machines was not appreciably different from that of the hand operation. Fewer people were required because 2 machine operators could accomplish about the same as 10 people stuffing and

crimping by hand. The servicing and inspection were both much easier when using the automatic machines. Additional machines were purchased, and before the New River Plant was shut down, four of these machines had been in operation for several months. This permitted catching up on all of the backlog of powder.

Considerable ammunition was in the South Pacific Area in an unuseable condition because of moisture absorption by the powder. The New River Ordnance Plant was requested to prepare "replacement" rounds for this ammunition. A "replacement" round consisted of sufficient increments for one full charge, all sealed into one long cellophane envelope. A number of these envelopes were placed in an asphalt-paper-foil envelope, which was then sealed. This was then put in a regular ammunition container. The loading of these rounds necessitated considerable changes in handling and inspection. This order was completed in a very short time after receipt of the necessary materials. There were no repeat orders. A considerable quantity of M2 increments for the 81 MM Mortar were packaged. This package was similar to that for the "replacement" round, except that there was only one cellophane envelope in each asphalt-paper-foil envelope. Packaging of this increment was stopped by the production of the M2A1 Increment, which replaced the M-2 increments.

During those periods, when insufficient work was at hand to keep the operators busy — that is, when there was a shortage of powder or cellophane envelopes -- the operators were used to dethread rejected increments. These increments had broken or torn flakes, were poorly sewn, or were otherwise imperfect. The dethreading operation consisted of removing the stitching from the increments so the powder could be

recovered by re-rolling at Radford. The efficiency of this operation was never very high.

Maintenance was never a serious problem on the Increment Packaging Line. During most of the period of its operation, there was one mechanic assigned to this work on each shift. He was able to take care of all repairs except those that required Machine Shop work. After nine-months-to-a-year's operation, the cams of the "Wrapade" crimpers became worn and had to be built up and re-machined. With the use of the automatic packaging machines, there was considerable shop work involved in sharpening the knives in the cut-off rolls and in re-machining the crimping rolls. The policy of having each automatic machine shut down once a week sufficiently long for a mechanic to make a thorough inspection and to make any needed adjustments or repairs resulted in a decrease in the amount of maintenance work necessary on these machines and in a considerable increase in the production per machine.

The facilities at New River were not adequate to meet the production requirements scheduled for the latter part of 1945 and the first part of 1946. In addition, loading schedules were so high that the buildings of Line 4 were required for bag loading. Accordingly, a new Packaging Line was designed and built at Radford Ordnance Works. Before this was completed, it was necessary for the packaging operation to move out of "A" Side of Line 4. The salvage operation was moved to temporary buildings in the Rolled Powder Area at Radford Ordnance Works. The hand packaging operations were moved to N o. 2 Igniter Line at New River Ordnance Plant. When packaging operations were started at Radford, the hand operations on the Igniter Line were stopped. By July 16, 1945, Radford was packaging sufficient powder to permit packaging operations at New River to be dropped to one shift. All operations at

New River Ordnance Plant were stopped on August 18, 1945.

Increment packaging continued at Radford Ordnance Works in Building No. 7800. This building was equipped with eight Ivers-Lee automatic packaging machines. By July 1, 1945, all trench-mortar powder produced at Radford by the Rolled Powder Area No. 1 was being packaged on four machines.

On August 20, 1945, the increment packaging operation was discontinued at Radford Ordnance Works.

5. Increment Salvage

In the production of rolled-powder increments, a considerable number of "reject" increments were obtained. Some of these were perfect increments except that they were underweight, that is, below the minimum weight allowable. It was customary either to dethread these increments and re-roll the powder or to sew additional flakes of powder onto the increment. Neither procedure was economical, but because of the critical shortage of raw materials, some method of salvage was necessary. Some of the rejects were merely poorly sewed. There was insufficient stitching in the increment to prevent loss of powder flakes in packing and loading.

It was obvious that if the powder were sealed in a cellophane bag, there could be no loss of powder even if no stitching were present. Therefore, increments with loose flakes could be used if they were inserted into the bag without loss of powder.

Tests by the smokeless chemical engineers at Radford indicated that an economical procedure for this could be worked out. The Packing Room of 4A Loading Building at New River was altered, and fourteen

Shadowgraph scales were installed. The salvageable increments were shipped from Radford to New River and each increment weighed. The operator adjusted the weight by inserting loose flakes of powder in the increment or by tearing off flakes if the increment were overweight. The weighed increments were inserted in the stuffing machine and bagged in the same manner as other hand-packaged increments.

The quality of the finished product was approximately equal to that of the regular hand-bagged powder. All lots of powder were well within weight specifications. The tightness of the package was governed by the quality of the cellophane bags available and was subject to the same variations as the regular hand-bagged increments.

There was considerable difficulty in obtaining a reasonably high efficiency in the weighing. This efficiency was increased by stressing the importance of the work to the operators, by informing the operators of the production expected of each of them, and by creating friendly rivalry between the operators and between shifts. Close supervision was necessary.

The cost of increment salvage was less than the labor cost of making new powder and considerably below the cost of dethreading and reworking the increments. Since this operation resulted in a considerable decrease in the amount of rework at Radford, the total powder available to the armed forces was increased by the amount of powder salvaged. For several months Radford was able to meet the schedules requested by the Ordnance Department only because of the added production resulting from the salvage operation.

a. Quality

At the time the Increment Packaging Facilities were installed, no specifications covering the packaged powder had been prepared. Tentative

specifications were set up at a conference at Radford just as operations were being started. A vacuum test to check the tightness of the package was set up. In addition, it was determined that all packaged increments must be given a visual examination to sort out defective seals. The Ordnance Department made a visual examination of a sample taken from each lot.

To insure maximum quality at all times, a checking system was set up on the line. Qualified operators were selected and assigned full time to the checking. The checking consisted of the following:

1. A vacuum test from each crimper.
2. A temperature check of each crimper.
3. An examination of the stuffed increments from each stuffer.

(Each of the above checks was made on a regular time schedule.)

4. The work of each inspector was checked each time she sent a tray of powder into the service lane for packing.
5. Visual examination.
6. Weight check.
7. Vacuum test.

As far as possible the identity of each operator's work was kept throughout the process so that in case of poor quality, the operator or equipment responsible would be known.

The quality of the final product was dependent upon the quality of the cellophane bags supplied. Many of the bags which appeared to be satisfactory were actually weak and would break open after packing. In addition, in dry weather the cellophane became brittle, and packages which were satisfactory when they left the line were broken open when examined at a later date. In moist weather the cellophane became sticky, and the packages would stick together after packing. After the development of an immersion test, it was discovered that a great many seemingly tight packages would admit water after a few hours' immersion.

The envelope suppliers all complained of the difficulty in fabricating envelopes of satisfactory quality from Saran-coated Cellophane.

Because of the difficulties in the use of Saran-coated Cellophane and the inadequate supply of it, an investigation of available materials was made. Du Pont 450 Gauge MSAT No. 84 Cellophane appeared to be satisfactory and was available. Authorization to use this type for half of the requirements was received in October, 1944. This proved to be much better in respect to strength of seal, resistance to immersion, uniformity, handling, etc.; it was not quite as good on moisture-vapor permeability.

The use of this material greatly improved the quality of the packaged increments when hand-packaging and when using the automatic machines.

In most cases when lots of packaged powder failed to meet the specification requirements, they were accepted on waivers. In a few cases where there were indications of poor supervision on the part of Hercules Powder Company, the lots were withdrawn and reinspected. The reinspection at best resulted in only slight improvement. Most of the lots reinspected were later accepted on waivers.

The Ordnance Department, particularly the Inspection and the Powder and Explosives divisions, worked very closely with Hercules Powder Company representatives. They kept informed as to the difficulties encountered, and wherever possible, altered specifications or granted waivers so that lots would not be rejected through no fault of Hercules Powder Company.

b. Production Efficiency

The production rate and efficiency varied greatly. During the first year of operation, there was a chronic shortage of cellophane bags. An adequate supply of bags was always promised so, as the packaged powder was urgently needed, an excess of personnel was normal.

Many "changeovers" in the type of powder being packaged were necessitated by shortage of the right type of bag or powder. This all contributed to poor efficiency.

An adequate supply of cellophane bags was received about the same time the first automatic machine was placed in operation. After this time, the operations were kept in close adjustment with the production of powder at Radford to reduce as far as possible the "changeovers" necessary. Efficiency on all operations increased rapidly and continued to increase until the operation was stopped.

c. Personnel

Except for the very few men required for hand-trucking and packing, female operators were used exclusively. These were under the supervision of a line foreman and house and area foreladies. The majority of the personnel were of an exceptionally high type and maintained a great interest in both quality and quantity of output. Nevertheless, absenteeism was always a problem.

The personnel assigned to the operation fluctuated widely with the supply of powder, bags, and the type of operation. Thus, with a big backlog of powder, a fair supply of bags, and emphasis on the salvage operation, the personnel was increased during the fall of 1944. Early in 1945 a reduced schedule necessitated a personnel reduction. The installation of more automatic machines caused a further reduction in spite of an increased schedule. The transfer of the salvage operation to Radford caused a further reduction.

d. Operations at Radford

The Increment Salvage House at Radford started operations in June, 1945, processing 60 MM M-3A-1 increments. Since this operation

continued only a short time, efficiency figures were unobtainable.

The salvage operation at Radford was discontinued on August 21, 1945.